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ABSTRACT

In the 1998-99 school year, the Arlington Heights School District 59 (Illinois) joined with the North Central Regional Educational Laboratory to evaluate the district's technology program, focusing on the impact of technology on engaged learning. The evaluation took place at a cluster of one junior high school and two of its feeder elementary schools. Findings suggest that teachers usually focused on one technology tool at a time when the structure is already in place for using multiple applications to engage students. The evaluation showed that teachers really did not know how best to use technology for instruction, even though the tasks they used were generally authentic and challenging to a degree. Evidence supported the idea that technology use supports student engagement, but that continued professional development is needed to enable teachers to use technology to enhance student learning. (SLD)

Educational Technology for Engaged Learning

District 59 Technology Program Evaluation

Summary

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Report Summary

The 1998-99 brought the District 59 and NCREL together to evaluate the districts technology program. The focus of the evaluation was to determine how "engaged learning" was translated and practiced in district classrooms. Through survey research, teacher and student interview, and frequent classroom observations, evaluation activities saw a number of instances of very careful and productive integration of the technology in student learning. To improve upon the learning experiences, the evaluators make the following formative conclusions.

Technology Use

Teachers are generally fixed at using one technology tool at a time when the structure is in place for using multiple applications to engage students. Teachers also seem reluctant to experiment with technology outside of functions that use technology as a presentation or product construction tool (kidpix, PowerPoint). To improve the breadth and depth of technology use, more global inservice is needed to help teachers go beyond the technology tools to support student learning. A good share of development must be the kind where teachers can communicate and collaborate together.

Four-Block Primary Level Reading Study

Findings here show close adherence to the four-block framework at the primary level. Print-rich classrooms, shared reading and writing, opportunities for every child to read and write daily, rhymes and chants to develop phonemic awareness, and opportunities to expand knowledge through science and social studies units were the cornerstones of the primary literacy instruction. As we looked at the use of technology in support of learning and teaching across the district, teachers clearly recognized that computer use can be a force in terms of supporting teaching and learning. We found that the most common teacher uses of computers were to access information and resources. Still, with professional development opportunities in how to use computers, *teachers still did not know how best to use technology for instruction.* Here again, the need for continued professional development in productive and integrated ways is illustrated.

Project-Based Learning and Technology

These tasks were generally authentic and challenging to a degree, and some were multidisciplinary. Students were given choices and opportunities to become explorers and investigators. There is some evidence that the teacher's role changed to "co-learner/facilitator." Yet, there is much more to the engaged learning experience, or any learning experience, than the tools and resources available to the student. The teacher's role with respect to the technology, the teacher's comfort with the technology, and the way the curriculum or task mesh with the technology are all critical factors. Teachers must be taught to work with technology at this level; their role as the gatekeeper and shepherd of innovation is critical for student success.

Finally, as the district continues to ask the question whether the technology is worth the expenditure, we can only offer two responses to this question at present: 1) The indicators appended to the report offer some evidence that student engagement is progressing well. There may be arbitrary value that administrators assign to these outcomes; and 2) The testimony of many teachers may also provide insight into the return-on-investment question. Otherwise, only a more carefully planned cost-benefit study will answer the expenditure question.

Introduction

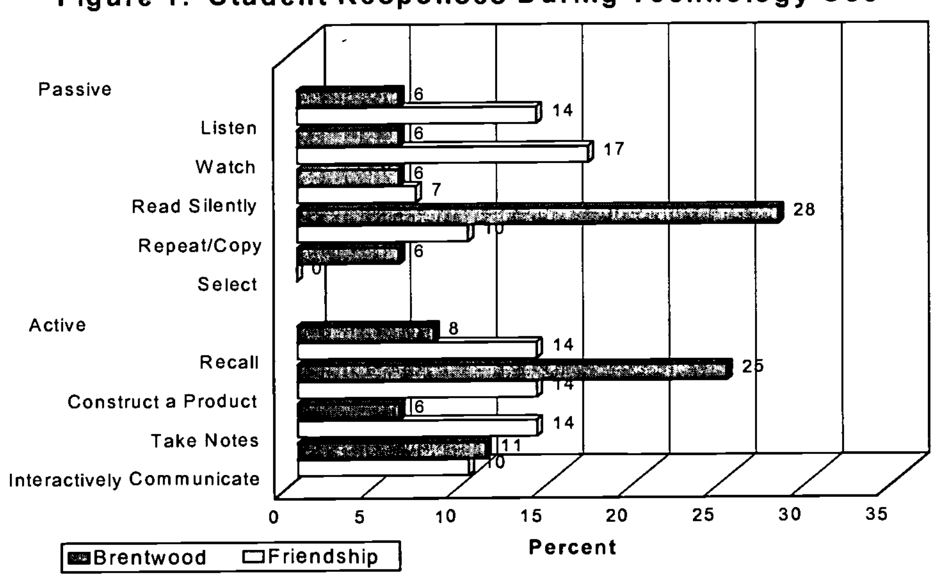
During the 1998-99 school year Arlington Heights School District 59 partnered with the North Central Regional Educational Laboratory to evaluate the district's technology program. Specifically, the evaluation was to determine the impact of technology on engaged learning.[1] The evaluation team employed a number of methods including a teacher survey, teacher and student interviews, and classroom observation. There are 13 schools in the elementary school district; the evaluation work took place exclusively in the Friendship cluster: Friendship Junior High School and two of its feeder schools, Brentwood Elementary and Robert Frost Elementary.

This report communicates key points of this evaluation and follows on the heels of presentations to and discussions with technology teams at each of the schools and the district school board.[2] Part 1 of this report summarizes the data on technology use; Part 2 focuses on the nature of the relationship between engaged learning and technology; Part 3 summarizes the findings of a small classroom study in reading.

Part 1: Characterizing Technology Use

Characteristic of most school technology programs, District 59 is a computer intensive environment where a few key applications compose most of the technology use. Those applications include word processing and graphic arts software. Other technology tools used include the Internet (used nearly a quarter of the time [23%] at the junior high level to conduct student research activities) and commercial multimedia (used 8% at the junior high level). At the elementary level, there is significantly less use of the Internet (8% of observations), but significantly more frequency of the use of multimedia software (16%) and commercial multimedia (11%). With their use of multimedia tools, elementary schools are most prone to construct technology-produced products whose complexity for grade level is fairly rigorous.

Figure 1. Student Responses During Technology Use



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[1] Arlington Heights Technology and Learning: A Formative Evaluation Plan, May 19, 1998
[2] Monthly meeting of the Arlington Heights District 59 School Board, June 14, 1999

When we look at how engaged the students are when using technology in two of the three schools under analysis, in terms of types of responses (see Figure 1), an equal amount of active to passive responses are produced.

While the definition of active and passive responses is debatable, it is reasonable to believe that students could be doing some of the same activities in class absent the technology, which raises the question, What added value does technology bring to the learning experience? Revisiting the purpose of the learning activities should help teachers better understand how technology can better support the learning experience.

Of the many cases where technology did have an influence on student learning, we asked teachers in the district (N=365) to identify the nature and intensity of that experience. On a scale of 1 to 4, where 1 signifies that the technology has ***no influence*** on the learning outcome and 4 signifies ***significant influence***, teachers rated a number of possible outcomes:

Students:

Have access to more information	3.21
Have more current information	3.15
Are better at working collaboratively	2.67
Apply themselves longer	2.65
Find expertise is more equally distributed	2.62
Use better communication skills	2.38
Are more responsible for their own learning	2.37
Have deeper process/content understanding	2.34
Have more understanding of the adult world	2.32
Have more interest in world cultures/events	2.31
Are better evaluators of information	2.23
Communicate better with adults	2.04

As the mean scores to the right of each outcome show, teachers feel technology has some influence on notable outcomes such as ***more responsibility for personal learning*** and ***deeper understanding of processes and content*** that comprise knowledge. Even greater influences are observed on ***communication skills*** and ability to ***apply themselves to their learning*** longer.

Teachers and Technology

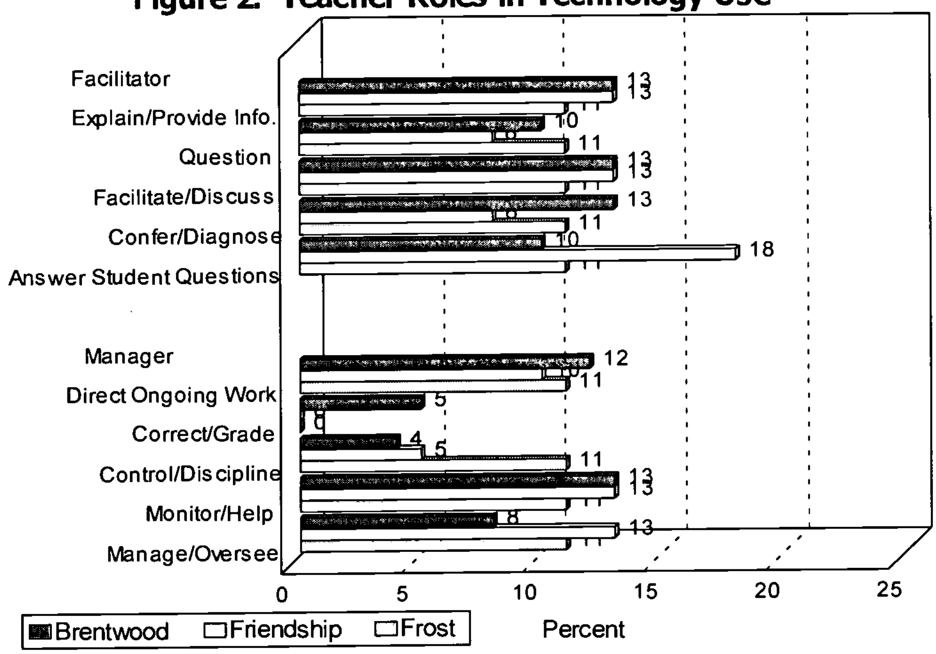
Much of what this evaluation attempted to do was to understand better how teachers go about their work when they integrate technology with instruction and to determine what influences technology has on their own work. When teachers were asked what activities they performed best involving technology, they said being able to identify the appropriate technology to put in use. Evaluative observations conflict somewhat with that report as we noted in several cases where the technology in use was severely underutilized and/or utilized with the intent to produce a product for which other means might have been better. Conversely, teachers' responses were very moderate about their ability to connect technology to curriculum objectives. Our observations and unit artifacts show, however, that teachers were very careful and instinctive about emphasizing and identifying objectives in a technology environment in which even the

most experiences educators have difficulty denoting sometime very subtle indicators of student learning.

We do agree with teachers that more development and experience is required to learn how to use the technology to effectively evaluate student learning and to manipulate the technology to respond to various levels of student expertise. Perhaps, most important, teachers (especially at the junior high level) require assistance in organizing and allocating technology to maximize its use in the classroom. In this case, it is a task of capitalizing on scarce resources.

An audit of teacher roles in technology use (see Figure 2) shows that teachers or other adults present play equal parts of facilitator and manager when technology is in use. Perhaps more so at the junior high than the elementary level, teachers act as facilitators. This is due to the maturity of the students and their ability to conceive and perform learning tasks.

Figure 2. Teacher Roles in Technology Use



There is one major barrier that stands in the way of making teachers feel more comfortable with the technology: a lack of time. If they had more time, teachers indicate they

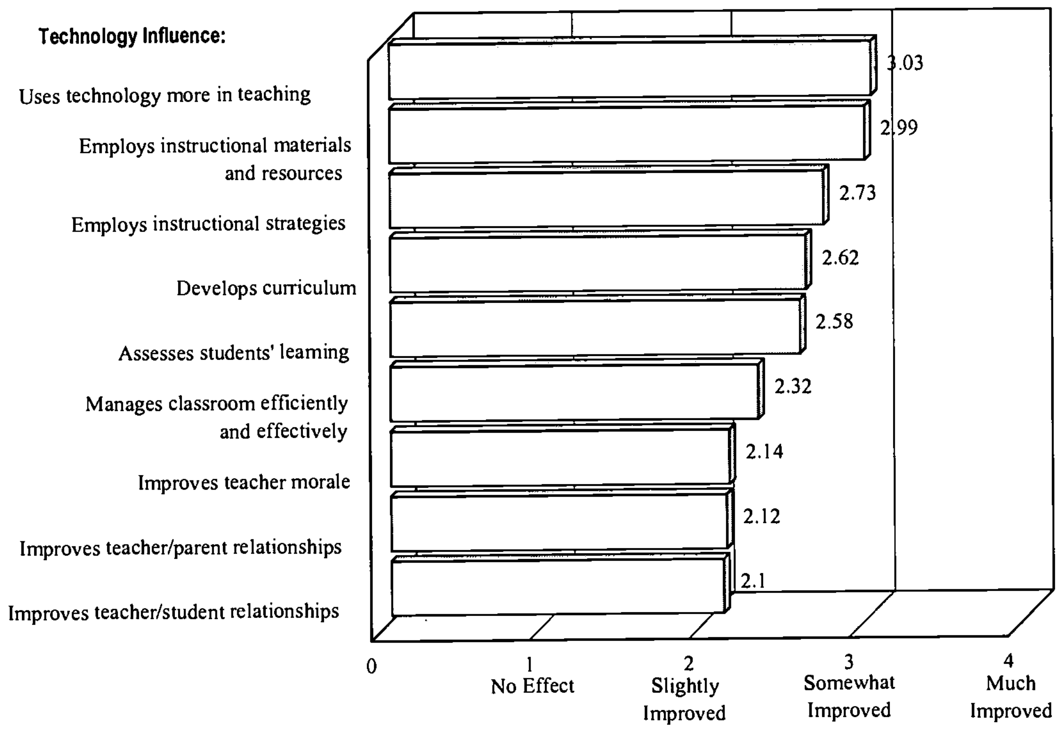
- Would be more familiar with the features of the technology.
- Would be more knowledgeable about the capacity of the technology to support various learning activities.
- Would have more opportunities to collegially interact with each other around the issues of integrating the technology into learning activities.

Schools continue to take responsibility for the social, emotional, and intellectual growth of many children. Teachers are willingly bearing the burden of those tasks but they have little time

available to focus exclusively on one facet of schooling. Technology will continue to have to compete for teachers' time with other events and issues related to American schooling.

The overall influence of technology on the professional activities of teachers is illustrated in Figure 3. Teachers report generally moderate improvement in many areas related to their professional growth.

Figure 3. Technology Usage Effects on Professional Activities



A Profile of Engaged Learning

To achieve a sense for the level of engaged learning of instructional practices supported by technology, 34 observations were conducted in the schools using the scales illustrated in Appendix A. Twenty-two indicators in six separate areas were characterized on a seven-point continuum and each observation included a rating on each of the 22 indicators. The scores on the continuum mark the average of the scores assigned.

Briefly, markings in the *teacher* area indicate a definite strength as teachers were observed creating opportunities for student to work collaboratively and to explore personal interests that related to student learning. *Tasks* were also a strength as many activities bore a close resemblance to real-word learning activities and built on the life experiences and interests of the students. Perhaps the lowest scoring area was that of the *students*, who appeared to be slow in adjusting to a learning context that was collaborative and placed more emphasis on the students' role in regulating and directing their learning.

Suggestions for Using Technology for Engaged Learning

Part 1 of this report briefly describes the outcomes of the first year of evaluation of the Arlington Heights District 59 technology evaluation. Technology use appears to be progressing well in the district but not without a few strains on both teachers and students as they learn to make the technology a useful part of their learning experience. We present the following points for consideration as the technology development process continues to develop in the district.

- Multi-tool use of the technology is rare and generally is the result of the encouragement of media library staff who works more frequently with the technology than do teachers. With more familiarity with its functions, teachers should be able to simultaneously use several technology applications (i.e., Internet, graphical information systems, communications tools, and media packages) to enhance instruction.
- Technology access continues to be sub-par at the middle school level. To become a fully integrated part of the curriculum, and to use the technology to encourage student inquiry and research on the medium, access has to be more robust.
- Teachers need more incentives to use technology in their curriculum. Too much of their technology use includes traditional applications. Time and peer collaboration would appear to be the key elements of more thorough technology use.
- Questions about technology effectiveness are important and relevant for the investment made. Though experienced external evaluation partners can help identify, describe, and quantify those impacts, much about technology's impact can be distilled from the teacher's experience in using technology. To draw on this rich source of knowledge, teachers can be trained to identify these impacts and collect data on them. Standard measures of impact from across the entire district can yield some powerful insights.

Part 2: Four-Block Primary Level Reading Study

NCREL research staff visited primary-level classrooms in which the four-block reading framework[3] are being implemented. Researchers collected data through informal interviews with teachers and students, and informal observations of classroom activities around two major research questions: (1) How is the four-block framework being implemented at the primary level and (2) How is technology being used to support reading and writing? Each researcher wrote detailed observation notes and organized the information according to the research questions. While the classroom observations were taking place, we sent questionnaires to the district curriculum and professional development coordinator, who then sent them on with a cover letter to the principal or technology coordinator at each selected school to distribute to the teachers. Schools returned the surveys directly to the district administrative office, which then sent them to NCREL.

[3] Cunningham, P., & Allington, R. (1999). *Classrooms That Work.* New York, NY: Longman

The four-block framework—guided reading, self-selected reading, writing, and working with words—provides numerous and varied opportunities for children to learn to read and write. Within every classroom there are lots of comings and goings in the day and lots of time lost getting settled and getting started. Ideally, all 220 minutes of reading time would take place in the morning. Not all the components of the four-block model can be used every day, but all the important ones should be implemented on a regular basis.

Every day

- Teacher reads to the class from a trade book.
- Teacher reads something to the class from a newspaper, magazine, riddle book, book of poetry, or other "real-world" source.
- Children read something they choose from a large and varied selection.
- Children learn more about the topic they are studying.
- Children do a word wall activity with high frequency, commonly misspelled words and/or with topic-related words.

Two or three times a week

- Children participate in guided reading/thinking activity.
- Children participate in a focused writing lesson.
- Teacher models topic selection and writes a short piece.
- Children write on a topic of their own choice.
- Children work with words—looking for patterns, learning how to chunk and decode big words, etc.

Once a week

- All children share something they have written.
- All children share something they have read.
- One-third of the class revises, edits, and publishes a piece of writing.
- Children read to their buddies
- Children do research related to their topic.

Our two major sources of data, the observation reports and teacher questionnaires, helped us to describe the four-block reading framework implementation and overall technology use within the district. For the description of instructional practices in reading, we used our observation notes to develop a matrix that included a list of key elements observed along one axis and the characteristics of the four-block model along the other. We tabulated the presence of these elements across classrooms, which helped us to summarize and describe the classroom observation data.

We used the teacher questionnaire data to highlight technology use observed during the site visits. This report contains a synthesis of practices in primary reading and technology use, and recommendations for further technology use.

Findings

Overall Findings

In general, we observed close adherence to the four-block framework at the primary level. Print-rich classrooms, shared reading and writing, opportunities for every child to read and write daily, rhymes and chants to develop phonemic awareness, and opportunities to expand knowledge through science and social studies units were the cornerstones of the primary literacy instruction. Across the classrooms observed, we noted that students consistently did the following:

- They wrote in whatever way they could and read what they wrote even if no one else could.
- They tracked print; that is, showed you what to read and pointed to the words using left-right/top-bottom conventions.
- They can recognize and write concrete words—their names, favorite words from poems, books, and chants.
- They demonstrated evidence of phonemic awareness—including the ability to clap syllables, recognize if words rhyme, make up rhymes, and stretch out words.
- They could name letters and tell you words that begin with the common initial sounds.
- They listened to stories and informational books and retold the most important information.
- They saw themselves as readers and writers.

Even though students in the classrooms we observed were at very different places, all seemed to be making progress toward achieving these critical understandings. Classrooms were organized to immerse children in literacy experiences. These experiences with print, stories, and books formed the base for teachers' instructional planning. Whole-class, small-group, and individual activities were designed to further students' literacy development.

Reading and Technology Use

As we looked at the use of technology in support of learning and teaching across the district, one finding emerged consistently from a variety of teacher questionnaire responses: the recognition that computer use can be a force in terms of supporting teaching and learning. We found that the most common teacher uses of computers were to access information and resources. *Teachers had professional development opportunities in how to use computers, but did not know how best to use technology for instruction.*

The primary-grade students and their teachers in our case study classrooms demonstrated an eagerness to learn and receptivity to technology. Having grown up in a highly technological world with access to countless engaging and motivational electronic games, it is little wonder that these students are generally familiar and comfortable with high-technology interfaces. The classroom arena in which we observed learning and development taking place was rich with materials that appeal to and stimulate all of a child's learning modes. However, in the classrooms that we visited, we observed little technology use to support reading instruction.

Technology appeared to be used primarily in the area of word processing for writing. Based on our observations and questionnaires, we have concluded that, in addition to the traditional manipulatives and hands-on resources, technology could become more of a powerful means with which to engage learners in District 59.

The infusion of educational technology into the early elementary classroom is an important way to reinforce the use of traditional manipulatives and hands-on resources via a medium that is well within the learner's worldly experiences. Computer-assisted instruction programs provide a fun way for children to receive additional practice in basic skills development. Primary learners are able to extend their language arts abilities through interactive engagement with CD-ROM stories. Learners can use their imaginations by writing a story using a word-processing program, or drawing or painting images with a computer. Children who demonstrate ease of use and an ability to use various forms of technology should be provided further opportunities to extend their proficiencies. Additionally, providing young learners with access to educational technology shows them that computers and other media are an integral part of lifelong learning and not an isolated element of their formal schooling.

Suggestions for Using Technology to Support Reading

There are good reasons for using the computer to assist reading, just as there are conceptual and methodological issues related to how best to do this. One main reason for using computers is that reading is a real-time language activity involving all types of available linguistic information. The earliest writers, kindergartners and first graders, use language to tell stories and illustrate them—wanting to communicate their own experiences and ideas. When writing or listening to a story, or working on projects using paint or graphics programs, children are also using spelling and vocabulary functionally. And as children use words, they begin to read.

The highly interactive and user-managed characteristics of technology lend themselves well to the practice and development of strategic reading. Using text, graphics, and sound in an engaging format, reading software (e.g., laser disc "books," integrated learning systems, and stand-alone reading games) can be easily adapted to progress at the speed and level of difficulty best targeted to each individual learner. Technology supports the interactive nature of the reading process by allowing the reader to be actively engaged in the text through audio, animation, and responses. New and improving technologies—such as speech recognition, synthesized/digitized reading of text, animation, and CD-ROM—will boost the learner's motivation and ability to expand upon existing reading capabilities. For example, the following reading activities can be presented, practiced, and explored in classrooms using educational technologies:

- Letter and word recognition
- Vocabulary development activities
- Decoding
- Comprehension
- Problem solving
- Critical thinking
- Determining themes

- Investigation/research
- Synthesizing.

The ability to develop, practice, and use language skills is an important factor in determining successful communication between the learner and the world. Using technology, the student practices both receptive (reading and listening) and expressive (writing, speaking, drawing, painting, and music composition) processing information.

Specific technology interventions that assist in this objective are:

- Software applications promoting the reading of content and instructions
- Video and cable presentations
- Telecommunications
- Distance learning
- Hypermedia presentations
- Speech synthesis software that reads text as directed by the learner
- Laser discs and CD-ROM software that present the learner with a variety of text, graphics, animation, and sound sequences for instructional support
- Word-processing programs
- Graphics, music, and other creative expression software
- Multimedia presentations that effectively combine a variety of resources for the purpose of sharing knowledge and ideas.

According to Chall's (1983)[4] six-stage developmental model of reading, children pass through a distinct decoding stage en route to fluency. The extensive reading needed to achieve fluency has conventionally followed the decoding stage because of the need to first establish a foundation of word recognition ability. However, the support offered by electronic scaffolding makes such reading possible before that foundation can support independent reading. In other words, electronic trade books may hold the potential of blurring the boundary between the decoding and fluency stages by permitting contextualized practice while decoding instruction occurs elsewhere. Such practice has always been possible, of course, whenever an adult or fluent child is available to provide assistance as needed. Someone who must necessarily attend to the entire reading episode must give this kind of assistance on a one-to-one basis. The logistics of rendering this sort of help, together with the potential for self-consciousness on the part of the beginning reader, sometimes make such an arrangement unfeasible. Electronic books can circumvent these limitations by scaffolding the beginning reader at all times. Thus, the decoding and fluency stages might progress virtually in parallel rather than in sequence, with the ultimate effect of accelerating the development of reading ability and enabling fluency to be attained at an earlier stage.

The notion of situating decoding instruction wherever possible in the context of meaningful reading is intuitively appealing. Such instruction takes advantage of teachable moments, thereby illustrating for children the relevance of learning about word recognition. It also avoids fragmenting language and proceeds from whole to part rather than from part to whole. Further, it

[4] Chall, J. S. (1983). *Stages of reading development*. New York: McGraw-Hill.

is precisely tailored to the needs of an individual reader, which is particularly relevant to reading in electronic environments in which only one child is interacting with the software.

Features that complement the basic word recognition effort afforded by talking books include the following:

Play Options: Special audiovisual effects, associated with illustrations, can be displayed by clicking meaningful parts of these illustrations. Some educators may complain about the distraction created by such devices, but adherents argue that they add appeal that the printed versions of the same books can never match. Moreover, the play option can be suppressed, if desired, or used prior to any serious reading of the book.

Embedded Tasks: A feature common to hypertexts entails confronting readers with occasional comprehension checks in the form of tasks to be completed. For example, before allowing a child to proceed to the next page, the computer might ask that the child "Show me _______," with the expectation that the child will then click at an appropriate point in the illustration. Embedded tasks of this nature would encourage, at an early age, reading for comprehension while reading for pleasure.

Resources: Devices such as glossary entries, explanatory notes, and simplified rewordings may prove useful to some beginning readers. Another resource that might serve a beginning reader is simplified paraphrases of text that are beyond a child's listening level. With such a resource, beginners would be able to derive from relatively advanced text an understanding more commensurate with their current knowledge. The limitation of inadequate prior knowledge suggests that another kind of resource would be aimed at building prior knowledge in order to facilitate comprehension. Informal measures of comprehension now routinely assess prior knowledge in order to judge the extent to which it may be a limiting factor, but complex hypertext networks often serve in effect to supply prior knowledge on demand as readers strategically make their way through the network. An electronic encyclopedia, for example, facilitates cross-referencing to locate articles that may help one better understand the entry with which one begins. A multimedia network might serve the same purpose for beginning readers without recourse to print. Clicking on various components of illustrations, for example, could lead to oral explanations and descriptions. Such a system might constitute an appropriate precursor of similar systems, involving text, that children will later encounter.

Visual Transformations of Text: Preschoolers and even kindergartners often lack prerequisite print concepts that enable them to access the pronunciations they need. Electronic texts could be formatted to introduce and reinforce concepts, such as word boundaries and the left-to-right and top-to-bottom directionality of print. Thin-lined boxes might be used to encase words, for example, a feature that could be suppressed for certain readers. Likewise, arrows could be used to indicate where to start and in what direction to proceed. These resources are forms of electronic scaffolds that would fade long before digitized pronunciations.

Labeled illustrations: Some commercial software companies use one-word labels for objects depicted in illustrations. Such labels appear as a child explores an illustration by clicking. The oral equivalent of a label is simultaneously provided. The labeling feature probably adds to the incidental acquisition of sight words facilitated by talking books.

A recent article by David Reinking (1995)[5] addresses the topic of electronic literacy. He reminds us that literacy is the condition of being able to read and write and that educators and educational policymakers need to expand the definition of literacy to include reading and writing not only of printed texts but of electronic texts. According to Reinking, some of the possible benefits of CD-ROM storybook reading include:

- Providing children with the meanings of words that may not be a part of their everyday speech.
- Engaging children in language play that is centered on the sounds of language.
- Fostering the ability to listen.
- Helping children to become aware of literacy conventions.
- Teaching children that language is symbolic, that the words and pictures in the book are not things but representations of things.

There have been negative connotations about students' interactions with computers. Some people may fear that the child works alone and becomes solitary, but the reality is that cooperative computer involvement necessitates the use of language so that learners can talk about their experiences with each other. Additionally, we should remember that the reading act itself is a solitary exercise when the reader interacts with the text and then may move on to the next step of sharing information received through reading by talking with his or her peers.

Suggestions for Using Technology to Support Writing

Using literacy to accomplish real tasks gave the computer a new role in the education of young children. Children who use word processors, especially talking word processing software, and who have teachers scaffolding or providing the support for parts children cannot do, write more, are less worried about making mechanical errors, make fewer mistakes, and produce high-quality content. Word processing with computers seems to support a constructive writing process and invented spellings, more so than when children write with traditional tools (e.g., pens and pencils). In general, children who write with word processors seem more motivated to write than when they just have pen and paper.

Overall, children tend to write and tell longer and more elaborate stories about computer graphics than they do about static pictures. Children also talk, draw, and write more with open-ended rather than drill-and-practice software.

[5] Reinking, D. (1995). Reading and writing with computers: Literacy research in a post-typographic world. In K. Hinchman, D. Leu, & C. Kinzer (Eds.), *Perspectives on literacy research and practice* (pp. 17-33). Chicago, IL: National Reading Conference.

Children write freely on the word processor. Some researchers find that children's word processing is more like speech than writing, and children choose to spend more time on language acquisition in classrooms with a word processor. When children are motivated by technology, learning is fun and students become actively involved in the learning process. The opportunity to develop language skills occurs when listening, reading, speaking, and writing skills are combined in real tasks. Language arts projects, such as having students use computers to develop a newspaper to be shared with parents and other students, can dramatically improve language mechanics while, at the same time, enhance students' attitudes toward writing and other language skills.

Writing curricula provide students with access to a technology-rich environment for individual and small group activities. These activities are directed at organizing and analyzing information to use in written communication. Students use related technology to draft, revise, and edit writing for a variety of audiences and purposes in all disciplines.

Process writing, with peer collaboration and critique, is a particularly effective activity in the technology-supported writing environment. Students are allowed to focus on content while learning to use resources such as spelling checkers and thesauruses. Editing, experimenting, and revising are also easily accomplished. Students can readily explore homophones, synonyms, alliteration, and word inventions to create vivid and interesting writing.

Electronic writing environments provide practice in producing personal and business letters, thank-you notes, forms, applications, and paragraph development. The publication of short stories, essays, and poems to be shared with audiences within and beyond the school district adds meaning, purpose, and motivation for writing activities. Software programs direct students to analyze novels and interpret essays and lead them through the development of personal essays.

Part 3: Project-Based Learning and Technology

Projects play an important role in learning. In a project, students engage in a complex process of inquiry (e.g., "How does that work?") and design (e.g., "But I want to do this.") The result is an artifact—a product of student knowledge that can be shared and critiqued. Projects that have successfully been used with middle and high school students include designing a solar house, modeling the effect of water pollution on a stream, and simulating two-dimensional projectile motion.

Orchestrating learning projects in the classroom can be a difficult task. A teacher has an enormous challenge in managing 20-25 students engaged in authentic project-based learning. The classroom management techniques designed to help structure classrooms working with project-based learning are not easy for teachers to learn and use. And, even when the orchestration works well, students still may not learn from a project. In some cases, students may not be able to recognize the learning goals of the project and may focus simply on completing tasks, rather than the process of learning.

What makes projects work? What makes orchestration possible and what makes student learning more probable? We do know from research that:

- Students need opportunities to reflect on their learning and the purpose of their project.
- For learning to occur, student goals must be focused on learning or knowledge building.
- Enough support must be provided so students can succeed. Too much support, however, can be overwhelming and too little support can make the task too great.

In this section, we will examine the ecology units developed at Robert Frost Elementary School in District 59. This school received a Student Power 2000 grant from Commonwealth Edison. They chose to focus on ecology and its many aspects to fulfill the specifications of the grant. The principal and staff of Frost Elementary made this project an all-school collaborative effort.

The staff formed an Ecology Planning Committee and began brainstorming ideas on which each grade level could focus. They decided they needed more information about planning both engaged learning and problem-based learning (PBL) units. After an initial meeting with NCREL and Frost staff, the Ecology Committee Planning Team recommended that NCREL staff meet with them to provide insights into engaged learning, PBL, and technology integration. The Committee needed these insights to begin planning for and involving the whole school in an upcoming all-school showcase for the students, staff, parents, community, NCREL staff, and representatives from Commonwealth Edison.

After this meeting, the Committee realized that even though problem-based learning was perhaps the ideal way to approach this collaboration, it was not the most appropriate because of time constraints. They decided instead on an adaptation of PBL that focused on engaged learning. Grade-level teams posed "fat questions" or "fat statements" to each other about ecology itself in order to gain background information to begin planning. Fat questions or statements serve as a broad problem that students attempt to solve or discover possible solutions. Following this brainstorming activity, the grade-level teams chose broad topics and planned accordingly: K: Animals and their habitats; 1-2: Recycling; 3: Rain forests: 4-5: Types of energy.

General Characteristics of Grade-Level Units

KINDERGARTEN:

Animals and their habitats

Where do animals live and is their habitat connected to their role within the big ecosystem?

- Links to Illinois Goals and Standards
- Assesses prior knowledge
- Allows for predictions
- Uses cooperative learning groups
- Uses real-life situations

- Allows for research and investigation
- Allows choice in the selection of animal to be studied
- Includes parent involvement both during the project and for the culminating activity
- Uses rubric assessment—embedded and ongoing
- Expects oral presentation about animal with expectations for presentation
- Expects electronic slide show as a collaborative project with upper-class buddies

GRADES 1-2

Recycling project[6]

Too much recyclable material is being put into the regular garbage. How can we solve our school problem?

- Links to Illinois Goals and Standards
- Assesses prior knowledge
- Allows predictions
- Employs cross-disciplined (math/science/drama/art)
- Uses real-life problems both within school and within the community/nation
- Uses cooperative learning
- Involves school maintenance personnel
- Uses rubric assessment throughout
- Expects technology project (Hyperstudio) as performance assessment

GRADE 3

Rain forest

Humans are destroying the rain forests more every day. The rain forest has been reduced from 20 percent of the Earth's surface to just 6 percent in recent times. What can we learn from the previous destruction to help us preserve it for future generations?

- Links to Illinois Goals and Standards
- Poses "fat question" to solve
- Accesses prior knowledge
- Allows choice in the selection of area to focus on
- Employs cross-disciplined approach (math/science/social studies/language arts)
- Allows for investigation/research
- Uses journal writing both for information gathering and assessment
- Uses real-life situation and application (collect and recycle pop cans to earn money to support a part of a rain forest)

- Organizes trip to Brookfield Zoo to visit a rainforest simulation

- Uses rubric assessment throughout and for culminating activity
- Uses technology for research/word-processing/KidPix Slide Show

GRADES 4-5

Types of Energy

What are the best uses for various types of energy (with emphasis and recommendations on how to "save" energy) within our

- Links to Illinois Goals and Standards
- Accesses prior knowledge
- Allows for hands-on investigations relating to types of energy
- Allows for parent involvement both as "experts" and as audience
- Uses cooperative learning
- Allows choice of projects for type of energy to study
- Uses outside source for information/classes on electricity and magnetism (trip to a Science Center in the area)
- Uses technology for multimedia presentation as culminating activity (Hyperstudio)
- Attempts rubric assessment for content for overall performance

Conclusions and Recommendations

Unit Content

Prominent among goals to improve student learning is the objective of increasing student ability to solve problems and demonstrate competency over changing subject matter, particularly in mathematics and science. Engaged learning involves students in the identification of a problem or goal of personal or group interest and the generation of activities and products designed to solve the problem or meet the goal. Within this framework, students pursue solutions to nontrivial problems, ask and refine questions, debate ideas, design plans and artifacts, collect and analyze data, draw conclusions, and communicate findings to others. Because they work with problems from their own real-world situations, students are more motivated to pursue a deep understanding of a cluster of topics across related domains. This approach contrasts with the traditional practice of superficial coverage of many topics in a single domain.

We looked at the project-based units for evidence that the tasks or activities:

- Have analogs in the real world, but also reflect students' interests.
- Are complex and open-ended, requiring students to work through the definition of the problem and regulate their own performance.
- Relate to practical situations so that experiences from work and daily living provide important information, strategies, and insights.

- Can be accomplished in multiple ways, typically with more than one good answer or outcome.
- Are performed by student teams, with different students taking on different specialized roles.
- Are performed with the same information and the same types of technology tools used by professionals.
- Result in a product that allows students to feel they are making a contribution to the larger community.

Each classroom we observed had a teacher computer station with classroom monitor and individual computer stations for student use. It is not clear, however, how much these computers are actually used to support learning within the school day. These tasks were generally authentic and challenging to a degree, and some were multidisciplinary. Students were given choices and opportunities to become explorers and investigators. There is some evidence that the teacher's role changed to "co-learner/facilitator." For the most part, assessment is performance based, and rubrics were adopted or created for the projects. In some instances, it is not clear if the rubric really assessed the content or even the overall performance. In addition, it was unclear to observers as to how students actually used technology to produce the end products. Did the teacher do the typing and/or creating of the project? Did the students type in the information with help from teacher/study buddy?

Unit Development

Project-based learning, particularly in terms of projects that emerge from student-identified interests, increases the complexity of planning and accountability. For teachers, the challenge of working with student-generated interests focuses on project development and efforts to make certain that students are challenged to accomplish important educational objectives within the curriculum.

There is much more to the engaged learning experience, or any learning experience, than the tools and resources available to the student. The teacher's role with respect to the technology, the teacher's comfort with the technology, and the way the curriculum or task mesh with the technology are all critical factors. Teachers must be taught to work with technology at this level; their role as the gatekeeper and shepherd of innovation is critical for student success.

A key insight that we have learned from working with teachers and students in the district is that it is not enough to simply elicit articulation. The process of talking about something does not necessarily lead to improved performance or learning. While evidence suggests that articulation is very valuable, students need guidance in how to articulate, what to articulate, and what to reflect upon in the articulation.

Web-SMILE (Web-Scaffolded Multi-user Integrated Learning Environment) is a Web-based collaboration tool integrated with scaffolding to support student design activities. Web-SMILE provides students with a flowchart of the things they need to do in the problem-solving process. Clicking on a box leads students to a page that describes what needs to be done and how the collaboration tools can be used in this stage. The tools are directly accessible with a click from

the stage description page. Web-SMILE communicates the process by describing how and when planning takes place, and links the scaffolding into tools for the design activity.

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